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78

MEDICOLEGAL INVESTIGATION
ON THE
DEATH OF
SENATOR ROBERT F. KENNEDY

Otiginally obtained by Lillian Castellano

THOMAS T. NOGUCHI, M.D.

DEPARTMENT OF CHIEF MEDICAL EXAMINER-CORONER
COUNTY OF LOS ANGELES

SURGICAL PATHOLOGY SLIDES FOR REVIEW

Microscopic review of surgical tissue sections from The Hospital of The Good Samaritan, received in this office on June 7, 1968. Sections are labeled B2411-68, and consist of three slides.

One section shows skin and subcutaneous fat. Only a small area of surface epithelium is present. Several pilosebaceous structures and scattered sweat glands are noted. Collagen of the dermis shows fragmentation and coagulation, and some coagulation of epidermis is also present. Extravasation of blood into the dermis is widespread, and early neutrophilic migration out of capillaries into dermis and subcutaneous fat is recognized. Scattered fragments of bone dust are spread through the disrupted dermis. Aggregates of fine brown granular material can be observed near and in the most disrupted dermal tissue. These are consistent with grains of gunpowder.

Another tissue section reveals small pieces of disrupted edematous cerebellar cortex without reaction or hemorrhage. Purkinje cells show variable degrees of distortion and nuclear pyknosis. Small pieces of bone are also present on the slide as are irregular pieces of blood clot and fibrin mesh with entrapped leukocytes.

The third slide is a section of a piece of gelfoam to which are adherant a piece of blood clot, a few bony spicules and sparse pieces of brain tissue. Some minute strips of tissue consistent with leptomeninges are also noted.

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CLINICO-PATHOLOGICAL CORRELATION OF SYSTEMIC AUTOPSY FINDINGS

INTRODUCTORY COMMENT:

The gross and microscopic findings obtained from the postmortem examination of the decedent have been correlated with information available from the clinical records of The Hospital of The Good Samaritan. Each organ system is reviewed, noting all changes and how these changes were manifested clinically. In addition, effects of therapy and the effects of the agonal events upon the gross and histopatholoigcal findings are described.

CARDIOVASCULAR SYSTEM:

The structure of the cardiovascular system appears to be within normal limits for the age of the decedent. There is no morphologic evidence of sustained hypertension, as the heart weight is normal and the myocardial thickness is also within the range of normal. No valvular deformities or abnormal intracardiac shunts are found to account for the systolic murmur reported in the clinical notes. No vegetations or antemortem marantic thrombi are seen grossly or microscopically. No myocardial necrosis of the type occasionally noted following the treatment of shock with vasopressors is identified in multiple sections. The coronary arteries reveal no evidence of significant luminal compromise by atherosclerosis. The minimal amount of interstitial edema within the myocardium is considered to be of agonal origin. The aorta and the venae cavae are within normal limits. No antemortem thrombus is recognized in the inferior vena cava in the region of the central venous catheter. The splenic vascular bed shows an amount of arteriolar hyalinosis normally seen in individuals of the stated age. Minimal fibrous thickening of the intima of intermediate sized renal arteries is also consistent with the age of the individual. The slight amount of hyalinosis of occasional periadrenal arterioles is also considered to be within normal limits.

RESPIRATORY SYSTEM:

The gross and microscopic changes described in the trachea are those usually found in comatose individuals in whom tracheostomy has been performed. The patchy denudation and regeneration of surface epithelium frquently accompanies measures utilized to keep the airway open. The are described in the microscopic notes as showing mucosal necrosis and acute inflammation is typical for the site of a tracheostomy tube. Such a lesion can show complete regeneration of epithelium folliwing removal of the tracheostomy tube. The degree of calcification of tracheal cartilage rings is usual for the age of the decedent.

The pulmonary alterations are those usually encountered in the comatose individual. Mild intra-alveolar and interstitial edema frequently appears during the agonal period of life. Some pooling of secretions in the dependent portions of the lungs and the accumulation of the edema fluid in the hypostatic areas have given rise to a mild bronchopneumonic process. No evidence of abscess formation is noted microscopically, and the bronchopneumonic process appears to be early, showing no evidence of organization. No microscopic evidence of oxygen toxicity is noted. The pulmonary septal cells are unremarkable. The thromboemboli described microscopically are small and infrequent in these sections. These thromboemboli appear to be of recent origin and are not associated with infarction. Material suggestive of necrotic central nervous system tissue is identified in two arterial branches. Such pulmonary embolization of central nervous system tissue is not infrequent in craniocerebral trauma in which large vascular channels have become disrupted.

HEMOLYMPHATIC SYSTEM:

The lymph nodes examined microscopically are within normal limits. The spleen demonstrates red pulp congestion such as is usually seen as an agonal event. There is no manifestation of systemic sepsis. The bone marrow reveals a slight erythroid hyperplasia, this change reflecting an early response to a major blood loss. The thymus demonstrates the usual residual atrophic lobules. Many small cystic structures derived from Hassall's corpuscles are found throughout the medullary portion. Such cystic changes are not clinically significant.

GASTROINTESTINAL SYSTEM:

The bacterial colonies identified in the hypercornified lingual epithelium are frequently seen on the tongue of an unconscious individual where there is no mechanical effect of chewing or swallowing to cleanse the surface of the tongue. No inflammatory changes are identified in the tongue.

The esophagus shows no evidence of mucosal erosion or ulceration and there is no evidence of esophagitis.

The stomach shows no evidence of mucosal erosion or ulceration frequently associated with central nervous system disorders. The minimal amount of superficial autolysis of the epithelium is consistent with the post mortem interval from pronouncement of death until autopsy. Of interest is the prominence of parietal cells in the gastric glands. The plasmacytic and lymphocytic aggregates within the lamina propria suggest a slight chronic gastritis.

No specific lesions are identified in the entire gastrointestinal tract.

PANCREAS:

The pancreas shows no gross or microscopic alteration of any significance.

The central venous congestion observed within sections of liver is a usual agonal event. No liver cell necrosis is observed and the liver is devoid of inflammatory disease. There is no demonstrable evidence of toxicity of any therapeutic agent in the material examined.

UROGENITAL SYSTEM:

The left kidney contains a solitary renal cortical adenoma and a renal cortical cyst. The adenoma is well circumscribed, small, and composes of benign renal tubular epithelial cells. Lesions of this type are extremely common findings in postmortem examination and are of no clinical significance. The solitary renal cortical cyst is of no clinical significance. The slight amount of compression atrophy of renal parenchyma adjacent to both the adenoma and the cyst is so minimal as to not compromise renal function.

There is no evidence of renal tubular necrosis morphologically demonstrable in right or left kidney. The minimal vacuolar change described in some of the proximal tubular epithelium is a frequent finding associated with mannitol infusion. Such changes are reversible. There is no evidence of infection involving the renal pelves or calyces or parenchyma. The vascular congestion described is considered of agonal origin.

The slight amount of calcification around basement membrane around collecting tubules identified in the renal papillae is of obscure origin. Such calcification can be seen in individuals suggesting large amounts of milk or alkali or vitamin D. It is of no clinical significance.

The mild edema, congestion and slight acute and chronic inflammation of the bladder neck is consistent with the presence of an indwelling catheter. The changes are mild. No ulceration of bladder mucosa is recognized. The small collections of acute inflammatory cells within the prostatic periuretheral glands are also consistent with the presence of an indwelling catheter. There is no evidence of hyperplasia of prostatic glands. The small calcific spherules and corpora amylacea within the prostate are frequent normal findings.

The testicular tissue is completely within normal limits.

ENDOCRINE SYSTEM:

The thyroid gland and pituitary gland show no gross or microscopic alteration.

The adrenal glands are small but within normal limits. The cortices are thin, have normal zonation and show decreased lipid. The adrenals frequently show this pattern in healthy individuals dying acutely due to various causes. The Decadron therapy was of too short a course to have caused significant suppression and atrophy of the adrenal cortex.

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NOTE: In the preparation of these opinions and conclusions, a number of diagrams, x-rays, and photographs, together with their descriptive notes were utilized as work documents consistent with generally accepted medicolegal practice. In each instance, these items support the findings and conclusions contained herein. They are, however, not included as part of this report, pursuant to the provisions of Section 129 of the California Code of Civil Procedure.

TTN:etf

SIGNATURES

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GENERAL MICROSCOPIC DESCRIPTION

CARDIOVASCULAR SYSTEM

HEART (Sections 72-12 A, B and C; 72-13 A, B and C; 72-14 A, B and C; 72-15 A, B and C; 72-16 A, B and C; 72-17 A, B and C; 72-18 A, B and C; 72-19 A, B and C; 72-23 A, B and C.)

Epicardial surfaces show flat sparse mesothelium. The epicardial fat is of normal amount. In a few areas there is the usual degree of insinuation of epicardial fat cells in the outermost myocardium extending between isolated fibers and bundles of fibers. All sections show regular myocardial fibers with central nuclei which are of consistent and regular size. Tinctorial characteristics are uniform with the usual degree of eosinophilia. Within the myocardial interstitium is a minimal amount of edema, usually located adjacent to small vascular channels. No myocardial necrosis, fiber fragmentation, or inflammatory infiltrate is observed. No microscopic intra-myocardial hemorrhage can be identified. The endocardial surfaces show an intact endothelium. The usual complement of fibrous connective tissue is present subjacent to the endothelium. Small tributaries of the coronary arterial tree included in the sections of heart show no intrinsic disease. No thrombi or emboli are identified.

AORTA (Sections 72-28 A, B and C)

The section is that of a complete circumferential segment of aorta. It includes intima, media and a generous portion of adventitia. The endothelial surface is intact. In a few random areas, minimally increased amounts of fibrous tissue can be noted beneath the endothelium. A few minute pools of mucopolysaccharide material are seen in the deep intima and inner most media. Only rare isolated foam cells can be seen immediately subjacent to the endothelium. The pattern of the elastic plates of the media is normally preserved. The adventitia consists of the usual loose collagenous connective tissue. The vasa vasorum extending from the adventitia into aortic wall are of normal caliber. No inflammatory infiltrate is identified in any layer of the aortic wall.

INFERIOR VENA CAVA (Sections 72-29 A, B and C)

The structure of the full thickness of vein wall is preserved. The endothelial surface is intact. The usual complement of subendothelial fibrous tissue is present which appears to be loosely arrayed bundles of collagen. The media of the vein shows the usual bundles of smooth muscle separated by collagen bundles. The smooth muscle gradually thins out as it approaches the adventitia which is composed of loose areolar connective tissue.

A few small nerve trunks and blood vessels in the adventitia are unremarkable.

CORONARY ARTERIES (Sections 72-23 A, B and C; 72-24 A, B and C; 72-25 A, B and C represent gross sections of branches of the coronary tree. Sections 72-26 A, B and C; 72-27 A, B and C represent longitudinal sections of coronary arteries.)

Cross-sectioned vessels show intact endothelial surfaces. No cross-sectioned branches show significant luminal compromise. There is a slight increase in fibrous tissue deposition immediately subjacent to the intima, blending with the muscular media. Rare isolated foam cells can be identified. No sharply defined plaques are observed. In a few areas, loose fibrillar appearing pink-staining material is noted in the subintimal connective tissue adjacent to the muscular media and is surrounded by small aggregates of fibroblasts, foam cells and rare lymphocytes.

The longitudinally sectioned arterial branches show no additional alterations beyond those previously described in the cross-sectioned segments.

RESPIRATORY SYSTEM

TRACHEA (Sections 72-4 A, B and C; 72-5 A, B and C; 72-6 A, B and C)

Sections of trachea include epithelium, cartilagenous rings and peritracheal connective tissue. There is focal denudation of the surface epithelium. In other areas the normal columnar epithelium is intact. Some evidence of early regeneration of denuded epithelium is noted. The tracheal basement membrane is irregularly thickened and eosinophilic. Immediately subjacent to it are aggregates of lymphocytes in a slightly edematous subepithelial stroma. Most of the tracheal mucous glands appear intact. A few of their ducts contain inspissated secretions. In one block (72-6 A, B and C) neutrophilic leukocytes are noted aggregating beneath the basement membrane. There is stromal hemorrhage adjacent to the neutrophils. In another section (72-5 A, B and C) necrosis of the epithelial and subepithelial tissue down to the level of perichondrium is noted. The areas of necrosis are manifested by loss of nuclei with persistent nuclear dust, smudging of blood vessels, and some extravasation of blood. The necrosis also involves mucous glands. At the junction of the vital and necrotic tracheal mucosa, neutrophilic leukocytes are gathered. The tracheal cartilagenous rings are viable. In all sections, some central cartilagenous calcification is noted. Some extravasation of blood into the peritracheal connective tissue is seen.

LUNGS (Sections 72-7 A, B and C; 72-8 A, B and C; 72-9 A, B and C; 72-10 A, B and C; 72-11 A, B and C)

Sections of pulmonary parenchyma are essentially similar to one another. All show moderate engorgement of the arterial bed with red blood cells as well as congestion of the alveolar capillary bed. In addition, precipitated proteinaceous edema fluid can be seen in many microscopic fields, located within alveolar spaces as well as within the perivascular and peribronchial interstitial tissue. Anthracotic pigment aggregates are sparse and collected in subpleural foci associated with slight fibrous tissue proliferation and lymphocytic aggregates. Other small aggregates of anthracotic pigment can be seen in perivascular and peribronchial location. Terminal bronchioles, respiratory bronchioles, and many alveolar ducts contain neutrophilic exudate. In some small respiratory passageways plugging by neutrophilic cells can be seen, while in other areas the aggregation is loose. In the areas of intra-alveolar neutrophilic exudation diapedesis of neutrophils through alveolar capillaries can be observed. In areas of the neutrophilic collections, fibrin mesh-works are noted. In a few alveolar spaces, fibrinous material appears compressed against the lining, but hyaline membrane formation is not a prominent feature in any of the sections examined. Larger bronchi, small bronchi and bronchioles of various caliber show prominent folding of their mucosal surfaces and some post mortem denudation of epithelium. In the areas of pulmonary parenchyma not involved with the pneumonitic process, slight hyperexpansion of alveolar ducts and alveolar spaces is noted. Several small pulmonary arterial branches contain thrombo-embolic material filling the lumen. No organization is observed. Search of vessels in the described sections reveals no obvious embolic central nervous system tissue.

LUNGS (Sections L20-1 A, B and C; L20-2 A, B and C; L20-3 A, B and C; L20-4 A, B and C; L20-5 A, B and C; L20-6 A, B and C; L20-7 A, B and C; L20-8 A, B and C; L20-9 A, B and C; L20-10 A, B and C; L20-11 A, B and C; L20-12 A, B and C; L20-13 A, B and C; L20-14 A, B and C; L20-15 A, B and C; L20-16 A, B and C; L20-17 A, B and C; L20-18 A, B and C; L20-19 A, B and C; L20-20 A, B and C)

Multiple sections of pulmonary parenchyma reveal varying amounts of red cell congestion of the capillary bed, exudation of neutrophilic leukocytes and proteinaceous material into scattered alveolar spaces, and precipitated edema fluid in other alveolar spaces. The changes are patchy. In some sections, there is collapse of individual pulmonary lobules. In other sections, small bronchi and bronchioles show post-mortem autolytic sloughing of the epithelium. Neutrophilic leukocytic aggregates are also seen in some bronchioles. In other fields, randomly scattered in the sections examined, hyperinflation of alveolar spaces can be recognized. In section L20-2 A, B and C, two small vascular channels contain aggregates of fibrillar to spongy, pale-pink staining material in which ghosted nuclear structure can be identified. This material suggests embolic autolyzed central nervous system tissue. Special stains for myelin will be prepared.

HEMIC AND LYMPHATIC SYSTEM

LYMPH NODES (Sections 72-35 A, B and C; 72-36 A, B, and C)

Two lymph nodes are represented in these sections. Slides 72-35 A, B and C show a node structure embedded in considerable fibro-adipose tissue. Within the fibro-adipose tissue, are several myelineated nerve structures. The lymph node itself shows a well-formed capsule. The subcapsular sinusoids are open. The lymph node cortex shows small reactive follicles. In the medullary portion of the node are aggregates of macrophages obscured by black pigment. The lymph channels in the medullary portions of the nodes are unremarkable. The lymph node represented on section 72-36 A, B and C demonstrates an intact capsule with small amounts of adjacent areolar tissue and a few tags of smooth muscle. In this node the subcapsular sinusoids are also open and lined by normal littoral cells. The node cortex has small, rather symmetrically distributed lymphoid follicles with visible reactive centers. Within the medullary portion of the node is a large amount of black pigment consistent with carbon incorporated into macrophages. The medullary lymphoid sinusoids are unremarkable. The reticuloendothelial cells lining the sinusoids are not unduly prominent.

SPLEEN (Sections 72-30 A, B and C)

The splenic capsule is intact and of normal thickness. The trabecular framework of the splenic parenchyma is unchanged from normal. Malpighian follicles are normally arrayed along the central arterioles. No significant reactive centers are identified. Some of the central arterioles show a mild to moderate degree of hyalinosis. Throughout the splenic section, red pulp sinusoids are engorged with red cells. The cell population of the red pulp is normal. No evidence of extramedullary hematopoiesis is seen. There is no acute splenitis.

BONE MARROW (Sections 72-31 A, B and C)

Section of marrow includes the enclosing cortical compact and medullary cancellous bone. The adjacent periosteum is of the usual thickness and composed of dense bundles of collagen and small numbers of fibroblasts. The bony cortex shows the usual lamellar pattern. The cancellous bone trabeculae are of the usual configuration. The marrow within the medullary space is cellular and is approximately 20 percent fat. The cellular maturation of all lines is orderly. Megakaryocytes are present. The myeloid to erythroid ratio is approximately 2.5 to 1, suggesting an early hyperplasia of the erythroid line. There is prominent activity of the normoblastic series in the marrow.

THYMUS (Sections 72-57 A, B and C; 72-58 A, B and C)

All sections show residual thymic elements embedded in lobulated fat containing several small blood vessels. The thymic lobules show nodular peripheral aggregates of mature lymphoid thymic cells. The medullary portions of the thymus are looser but are composed of lymphoid cells in a delicate reticular stroma. Hassell's corpuscles are prominent in all sections. Many show prominent cystic change and the cystic areas are filled with flakes of keratin-like material and epithelial cells with occasional formation of epithelial pearls. Amorphous flocculent pink-staining material surrounds the recognizible ghosted areas. There is no evidence of reactive lymphoid follicular activity within the thymus.

GASTROINTESTINAL SYSTEM

ESOPHAGUS (Sections 72-37 A, B and C)

The section is that of a complete cross-sectional representation of esophagus. Outer adventitial fibro fatty tissue tags are present. The circular and longitudinal muscles, bundles and associated nerve filaments and ganglia are normally distributed. The submucosa consists of rather loose areolar connective tissue. The muscularis mucosae is prominent but not abnormally thickened. The submucosa contains small clusters of lymphocytic cells near blood vessels. The esophageal squamous epithelium is intact and shows normal maturation from basal layer to the lumen. The section appears to represent mid-esophagus as no outer skeletal muscle attachments or submucosal gland structures are identified.

TONGUE (Sections 72-1 A, B and C)

This section includes a generous strip of lingual mucosa, subepithelial tissue and a prominent mass of lingual skeletal muscle. The epithelial surface shows numerous filiform papillations. The tips of the papillae are covered with slightly hypercornified squamous epithelium. The epithelial maturation appears orderly. Numerous bacterial colonies are present in the exfoliating squamous cellular debris. Colonies appear to be predominantly coccal. The lingual musculature is entirely within normal limits. There is no evidence of inflammation.

STOMACH (Sections 72-38 A, B and C; 72-39 A, B and C; 72-40 A, B and C)

All sections reveal similar features. The gastric serosa and muscularis are unremarkable. The gastric mucosal folds are prominent. The epithelium is moderately well preserved. Some superficial autolytic loss of the columnar surface epithelium adjacent to the gastric pits is noted. Between some mucosal folds are aggregates of entrapped mucus, containing exfoliated surface cells. The capillary bed of the mucosa appears engorged. Surrounding the necks of the gastric glands are rather prominent aggregates of plasma cells and occasional lymphocytes. In a few areas these cellular aggregates extend through the full thickness of mucosa and form small mononuclear aggregates at the junction of mucosa and muscularis mucosae. A distinctive feature observed in all sections is prominence of the parietal cell population of the gastric glands, with relative reduction in the zymogen cell population. The muscularis mucosae is of normal thickness. Submucosal tissues are of loose areolar type and contain engorged thin-walled blood vessels.

PANCREAS (Sections 72-41 A, B and C)

The sections are similar to one another. All show well preserved lobular pancreatic tissue. The vascular bed is mildly to moderately congested. Occasional fat cells are present within the lobules themselves, but there is no fat in the interstitial tissue. Several interlobular ducts and some intralobular ductal elements contain inspissated proteinaceous pink-staining material. The epithelium within most ducts is well preserved. Only rare pancreatic acini show ectasia. There is no interstitial inflammatory reaction identified. The islets of Langerhans appear normally distributed through the lobular parenchyma and show no evidence of hyalinization. There is no evidence of arteriolar sclerosis.

LIVER (Sections 72-42 A, B and C)

All sections are similar. The liver lobular architecture is well preserved. The portal triads contain no inflammatory cell infiltrate. The portal vein tributaries, hepatic artery tributaries and bile ducts are unremarkable. The central veins show mild to moderate engorgement by red blood cells. Some congestive changes in the innermost pericentral sinusoids are also observed. The liver cells are arranged in plates of single cell thickness. There is minimal edema of the spaces of Disse. The cells of von Kupfer are normally distributed. There is no evidence of cholestasis. The pericentral liver cells contain the usual complement of lipochrome pigments.

GALLBLADDER (Sections 72-43 A, B and C)

A section of gallbladder shows extensive autolytic changes involving the mucosa, with all the cells apparently ghosted' and anucleated. The gallbladder muscular coat is unremarkable. The liver bed of the gallbladder is included in the section and shows unremarkable liver cells at their junction with the pericholecystic connective tissue.

UROGENITAL SYSTEM

KIDNEYS (Sections 72-44 A, B and C; 72-45 A, B and C; 72-46 A, B and C; 72-47 A, B and C; 72-48 A, B and C; 72-49 A, B and C; 72-50 A, B and C; 72-51 A, B and C)

Sections of kidney show moderately well preserved tubular elements and intact glomeruli. Most of the interstitial renal vascular bed is engorged with red blood cells. The glomerular capillary bed shows red blood cell engorgement. There is no evidence of renal tubular necrosis. In some sections, proximal tubular epithelium shows a slightly vacuolated to ground glass appearance suggestive of a minimal osmotic nephropathy. Only rare glomeruli in multiple sections examined show ischemic obsolescence. In general, small arteries of arcuate to interlobar size show slight intimal fibrous thickening. No significant arteriolar hyalinization is found.

Sections taken from blocks 72-44 and 72-45 include an adenomatous nodule within the outer cortex. This nodule appears well encapsulated by dense hyalinized fibrous tissue. A few central fibrous trabeculae course across the nodule. The nodule is composed of sheets, cords and tubules of small cuboidal to columnar cells, occasionally arranged as papillary fronds. The cells have sparse pale pink vacuolated to finely granular cytoplasm and large oval to rounded basophilic nuclei.

No mitotic activity is recognized within the nodule. No insinuation into blood vessels or the surrounding renal parenchyma is observed. There is scarring with associated tubular atrophy and some glomerular distortion and compression in the cortex immediately adjacent to the nodule.

Sections from blocks 72-46, 72-47, and 72-48 include the grossly described renal cyst. The cyst wall is composed of hyalinized fibrous connective tissue. The lining consists of sparse cuboidal cells. The renal parenchyma immediately adjacent to the cyst wall shows a generous rim of atrophic cortical and medullary tubules, compressed and distorted glomeruli, clusters of hyalinized glomeruli, and a minimal lymphocytic infiltration. These changes are consistent with pressure atrophy. Some small blood vessels in this area immediately adjacent to the cyst show prominent fibrosis.

Sections of the kidney including the papillae as they enter the calyces show normal endothelial lining the calyces and a normal fibrous and muscular calyceal wall. The tip of a papilla is covered with unremarkable cuboidal epithelium. The collecting tubules appear unremarkable except for a rare focus of calcium salt deposition in their basement membranes.

BLADDER NECK - PROSTATE (Sections 72-52 A, B and C; 72-53 A, B and C; 72-54 A, B and C)

Sections examined from block 72-52 include bladder with bladder neck and prostatic junction. The bladder wall musculature is unremarkable. The blood vessels immediately subjacent to the bladder epithelium are markedly congested with red cells. There is some loss of the transitional epithelium. In its place neutrophilic leukocytes and occasional mononuclear cells are clustered. The sub-epithelial tissue extending into the muscularis shows moderate edema and associated chronic inflammation. In the prostatic uretheral portion of the specimen, there is also sub-epithelial edema and mild inflammation. The prostatic glands at the junction of bladder neck and prostate show normal papillary epithelium of columnar type, with basally located nuclei. No atypical features are identified. Sections from blocks 72-53 and 72-54 show only prostatic elements. The fibro-muscular stroma is unremarkable. The glands are arranged in their normal manner. The epithelium is intact. A few small ductules contain neutrophilic leukocytes and proteinaceous debris and are surrounded by mononuclear cells and rare neutrophils. Other glandular elements contain inspissated proteinaceous material, rare corpora amylacea, and a few small calcific spheryles.

TESTIS (Sections 72-55 A, B and C)

Sections are essentially similar to one another. The tunica albuginea is thick and composed of laminated collagen bundles. A few minute ductular epithelial rests lined by cuboidal columnar cells and containing inspissated pink-staining material are seen within the tunica albuginea. The testicular parenchyma shows the usual tubular pattern. There is mild interstitial edema. Interstitial cells are arranged in small and large clusters. Many show golden pigment within their eosinophilic cytoplasm and a few contain crystalloids of Reinecke. The parenchymal tubules show mild basement membrane thickening. Most tubules show orderly spermatogenesis extending through spermatozoa formation. Only rare tubules appear to show absence of spermatozoa formation and in these, spermatids can be identified.

ENDOCRINE SYSTEM

THYROID (Section 72-56 A, B and C)

The thyroid follicles show mild to moderate variation in size.

Most contain rather abundant colloid. There is peripheral scalloping of colloid in a few follicles. The thyroid epithelium is generally low and cuboidal. A rare thyroid follicle shows squamous metaplasia. There is no evidence of interstitial inflammation, edema or fibrosis. Intrathyroid blood vessels are unremarkable.

PITUITARY (Sections 72-59 A, B and C; 72-60 A, B and C; 72-61 A, B and C; 72-62 A, B and C; 72-63 A, B and C; 72-64 A, B and C)

Multiple sections of the pituitary includes anterior, intermediate and posterior portions. The connective tissue capsule around the pituitary shows focal extravasation of blood. There is no hemorrhage within the substance of the pituitary, however. The anterior lobe contains the usual complement of cells of eosinophilic, basophilic and chromophobic types. The eosinophils show the usual nodular aggregation along the anterior pole. There is no evidence of necrosis of pituitary cells. Within the pars intermedia a few colloid filled cystic structures lined by attenuated cuboidal epithelium are seen. The posterior lobe has the typical neural appearance and is unremarkable.

ADRENALS (Sections 72-65 A, B and C; 72-66 A, B and C; 72-67 A, B and C; 72-68 A, B and C)

All sections of adrenal are essentially similar. All show a connective tissue capsule composed of dense hyalinized fibrous tissue containing fibroblasts. This capsule has a sharp junction with the surrounding periadrenal fat. Some of the periadrenal fat is of the fetal type such as is frequently seen in this region. A few small arterioles in the adrenal capsule and perirenal fat show minimal hyalinization of their walls. No extracapsular cortical nodules are identified. A few intra-capsular microscopic aggregates of adrenal cortical cells are seen. The adrenal cortex shows well demarcated zonation. The glomerulosa is well formed and easily demarcated from the fasciculata. There is no significant nodularity identified within the cortex. The cells of the fasciculata have pale pink cytoplasm which is granular to finely vacuolated. The vascular bed appears mildlycongested in the reticularis; in some sections it is moderately to markedly congested as it approaches the medulla. The reticularis shows cells having rather dense eosinophilic cytoplasm. There is the usual interdigitation of reticularis with the adrenal medulla. The medullary cellular elements are well-preserved. The usual thick walled venous channels are seen within the medulla.

PERIPHERAL NERVOUS SYSTEM

PERIPHERAL NERVE (Sections 72-72 A, B and C)

Peripheral mylineated nerve including its epineural connective tissue shows well formed axonal structures with the usual complement of Schwann cell nuclei distributed in a normal manner. No diagnostic changes are recognized.

MISCELLANEOUS

Slides labeled 72-2 and 72-3 A, B and C are sections of pieces of gelfoam covered peripherally with blood clot, and showing early migration of neutrophilic leukocytes into the more peripheral interstices.

Slides labeled 72-32, 72-33, and 72-34 A, B and C and 72-22 A, B and C are all pieces of blood clot; no lamination or organization is present; and the material appears to be of either agonal or post-mortem origin.

Slides labeled 72-21 A, B and C and 72-20 A, B and C show pieces of gelfoam infiltrated with red cells, neutrophils and lymphocytes. Fibrin and red cells are at the periphery.

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OTHERS PRESENT:

Other individuals were present from time to time during the autopsy for various purposes. Names of these authorized persons appear on rosters maintained by the Department and other agencies also bearing responsibility for the security of the autopsy room.

PATHOLOGIST FOR GENERAL MICROSCOPIC STUDIES AND CLINICO-PATHOLOGIC CORRELATION:

Victor J. Rosen, M.D.
Deputy Medical Examiner

ADVISORS NOT PRESENT AT AUTOPSY:

William G. Eckert, M.D.
Pathologist to St. Francis Hospital, Wichita, Kansas

Russell S. Fisher, M.D.
Chief Medical Examiner
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Edward H. Johnston
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Bruce H. Smith, Jr.
Captain, MC, USN
The Director
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Cyril H. Wecht, M.D., LL.B.
Chief Forensic Pathologist
Allegheny County, Pennsylvania and
Director, Pittsburgh Institute of Legal Medicine

TTN:JEH:etf

NEUROPATHOLOGY

Inspection of the head and removal of the brain, spinal cord and temporo-occipital bone began at 7:40 A.M. and was completed at 9:15 P.M., June 6, 1968, in the autopsy room of The Hospital of The Good Samaritan, Los Angeles, California.

Preliminary examination of the brain and cranial wound was made by 10:00 A.M., including two horizontal sections through the midbrain and upper portion of the pons.

The specimens were then placed in 10 percent neutral formalin for fixation and transferred to the laboratories of the Chief Medical Examiner-Coroner, Hall of Justice.

At 4:00 P.M., June 6, 1968, after six hours of preliminary fixation, the brain was cut in six coronal sections and examined. Records were made of all gross findings.

At 7:00 P.M., June 7, 1968, the brain was further cut into 13 coronal sections and re-examined. All lesions and their locations were again confirmed and descriptions checked for accuracy.

Color photographs and radiographs, including internal carotid artery angiography, were made at different stages of examination.

RADIOGRAPHY

Radiographs of the brain specimen were taken on June 7, 1968.

ADDITIONAL PHOTOGRAPHY

Infra-red and black-and-white photographs of scalp hair, gunshot wounds and of skin from the right ear were taken on June 8, 1968.

AT-SCENE INVESTIGATION

At-scene investigation at the Ambassador Hotel, 3400 Wilshire Boulevard, Los Angeles, was conducted by Dr. Noguchi and Commander Stahl on June 8, 1968.

Additional ballistic aspects were considered during a follow-up at-scene investigation with Mr. DeWayne Wolfer, Los Angeles Police Department and Drs. Holloway and Noguchi on June 11, 1968.

TEST FIRINGS

Test firings were conducted on June 11, 1968, using a weapon and ammunition supplied by the Los Angeles Police Department as being of the most nearly identical manufacture possible to that of the fatal weapon. An area adjacent to the firing range on the Los Angeles Police Academy was utilized. Personnel consisted of Drs. Holloway and Noguchi, Mr. DeWayne Wolfer and Sgt. William J. Lee. Preliminary studies were with a target composed of a single layer of muslin over 3/8 inch (9 mm) gypsum board. The muzzle was perpendicular to the target unless otherwise noted.

A firm contact firing shows a circular defect about 3/8 inch (9 mm) in diameter, surrounded by a concentric zone of powder deposition about 7/8 inch (22 mm) in diameter and sometimes having a multi-laminar configuration at the periphery. These are on the outer surface of the muslin. Also evident on the under surface is a concentric zone of pale soot deposition about 3 inches (7.5 cm) in diameter.

At a 1/4 inch muzzle distance, there is a 5/16 by 1/4 inch (7.5 x 6 mm) defect with transverse ripping of the fabric over a zone 1-1/2 inches (3.8 cm) in length and about evenly divided bilaterally. Also present is a concentric zone of dense, dark gray discoloration one inch (2.5 cm) in diameter with irregular "clouding" within a zone up to 2-1/2 inches (6.3 cm) in diameter. Several faint radial smudges are identified as corresponding roughly with the known land-and-groove characteristics of the test weapon.

A firing at 1/2 inch muzzle distance is similar in configuration except for the absence of ripping of the target fabric and absence of land-and-groove "puffs." Visually detected powder residue is present in a zone having a maximum diameter of about 6 inches (15 cm).

At one inch distance there is the usual central defect and dense but comparatively homogeneous smudging up to a radius of 1-5/8 inches (4.2 mm).

A firing at 2 inch muzzle distance shows fairly homogeneous but comparatively lighter smudging up to a radius of 2-1/4 inches (5.6 cm). Discrete tattoo particles are now seen in a central zone up to 7/8 inch (2.2 cm) in radius.

The 3 inch distance firing shows pale mottling of powder residue within a radius up to 2-1/4 inches (5.6 cm), as well as finely dispersed powder granules up to a radius of about 1-3/4 inches (4.4 cm).

At 4 inches there is a pale smudging zone up to 1-3/4 inches (4.4 cm) in radius. In sharp contrast, discrete powder tattoo particles are identified out to a radius as much as 2 inches (5 cm).

Target configuration was then changed as follows. A single layer of muslin was placed over several crumpled thicknesses of the same fabric. Additional firings at close contact, loose contact, 1/8 inch (3 mm), 1/4 inch (6.5 mm), all show patterns similar to those on the original target.

A series of firings was then performed using geometry simulating that of the fatal gunshot wound to the head, as determined by previous studies. The post-auricular region was simulated by the padded muslin described above. The ear was simulated by an animal ear obtained from an abbatoir and with the hair removed.

With the test weapon at an angle of 15 degrees upward and 30 degrees forward (to correspond with goniometric data) and at a distance of one inch (2.5 cm) from the edge of the right "ear," the test pattern is most similar to the powder residue pattern noted on the Senator's right ear and on hair specimens studied. Similarity persists, on the 2 inch (5 cm) distance firing, with respect to the distribution of discrete powder granules.

TTN:JEH:etf

DESCRIPTION OF SPECIAL PHOTOGRAPHY AND RADIOGRAPHIC STUDIES DONE JUNE 7, 1968, AT THE PHOTOGRAPHY DEPARTMENT, LOS ANGELES POLICE DEPARTMENT, AND AT THE GOOD SAMARITAN HOSPITAL.

Report of supplemental examinations done on the brain and various associated bony tissue obtained both at the time of surgery and at autopsy.

2:10 P.M. on June 7, 1968

The undersigned and Colonel Pierre A. Finck took the fixed and previously partly sectioned brain specimen, along with bone fragments submitted from the Surgical Pathology Department, Good Samaritan Hospital, and a segment of skull removed at autopsy (to include the surgical margins of the wound of entry to the head and a portion of the associated trajectory zone) to the Los Angeles Police Department Crime Laboratory by prior arrangement. It was recommended by the Director of the Scientific Investigation Division of the Los Angeles Police Department, Captain Martin, that the contemplated x-ray studies might be better accomplished at another facility. There was, however, at our disposal, the services of the Photographic Department of the Los Angeles Police Department and the following photographs were taken by James Watson, Senior Photographer, under our direction:

1. Segment of bone removed at autopsy from the right mastoid region, internal aspect, infra-red at a ratio of reproduction of 1:1 on the negative.
2. The external aspect of the above specimen, infrared technique.
3. External aspect of the above specimen; black and white; pan.
4. Internal aspect of the same; black and white; pan.

The foregoing photographs are all on 4 x 5 material and all bear the identification No. 68-5731, the autopsy number.

5. A 1:1 ratio photograph of various fragments of bone submitted from the Surgical Pathology Department of Good Samaritan Hospital under their number B-2411-68. Pan film; millimeter scale included in photograph.
6. An infra-red study of the same material in the same orientation and at the same scale.

The above negatives, having been exposed and developed and showing adequate representation of the fractures sought, were left for printing by the Los Angeles Police Department photo lab.

We left the Los Angeles Police Department Building at 4:10 P.M. to pursue the x-ray studies at The Good Samaritan Hospital, Department of Radiology. These were done in the company of and with the kind consultation of Drs. R. L. Scanlan and J. D. Camp. The x-ray technician for these studies was Mr. G. O. Drianis. We arrived at The Good Samaritan Hospital at 4:15 P.M. for these studies.

The first studies were of the brain slices re-assembled in the best approximation of their original anatomical positions and x-rayed with the cerebellum approximated in situ as well (two exposures, radiation entering at the vertex).

The thus assembled brain was then x-rayed in a similar manner; but with the cerebellum detached slightly along the mid-sagittal axis (four films).

The segment of skull excised at the time of autopsy and containing both the surgical defect and portions of the wound of entry to the head was then x-rayed with the specimen in as intimate contact with the film plane as possible and thus very nearly representative of a perpendicular view through the center of the surgical defect, but not the wound of entry. Two exposures of this aspect were made. The specimen was then rotated 90 degrees so as to provide a somewhat lateral view with reference to that portion of mastoid in the specimen. The specimen was supported for this study by a balsa wood block. Two exposures were made at varyingly perpendicular planes to the foregoing. The above-mentioned four exposures are all contained on one sheet of film.

Composite films embodying visible evidence of the gunshot wound to the head were then made, including that portion of dura in which the traumatic and surgical defect was present, a portion of posterior aspect of temporal lobe nearest the wound of entry, and the two portions of cerebellum as previously sectioned by the Neuropathologist. Four films of this configuration were taken to include some variety of roentengraphic technique in view of the considerable variation of geometry in the specimens studied. All of the foregoing described films bear the autopsy number 68-5731.

The next study was a series of two exposures on one sheet of film of the collection of bone fragments obtained at time of surgery (or a portion of these same). The fragments were oriented to emphasize two particular fragments, larger as it happened, which show on infra-red negatives some reaction in that spectrum. The two fragments are at the upper portion of the x-ray field, the lower aspect being delineated by the number B-2411-68, Surgical Pathology accession number for this specimen at The Good Samaritan Hospital. Again a varying technique was used to afford a more meaningful interpretation of radio-dense areas.

Returning to the brain specimen proper, the re-assembled specimen was then arranged in a serial manner commencing from anterior and proceeding posteriorly with the arbitrary assignment of alphabetical designation of the slices which had been previously chosen by the Neuropathologist.

This first film includes arbitrary sections A, B and C. A letter R designates the right hand side of the array. The next film in this series includes arbitrary sections D and E. The next film includes arbitrary sections F, G and H, with the addition of a separate segment of cerebral cortex and associated hemorrhagic material known to have come from the region of the wound of entry to the head. The latter material bears the designation F-1. This series ends with section H which represents the terminus of the occipital lobes.

The next film is a composite of arbitrary section F, its accompanying fragment F-1, and separated views of cerebellum. Alignment of these specimens on the film is such that the mid-sagittal plane passes perpendicular to the film; the separate fragment of cerebrum and the associated hemorrhagic material are comparably distant from the midline; and the ventral portion of the cerebellum (including the pons) are similarly aligned. The remaining portion of cerebellum is then placed to the left of the ventral portion but along the same axis of lateral displacement.

The next film includes the foregoing configuration and adds the portion of dura which was originally fixed in formalin with the brain and which includes the traumatic and surgical defect.

The last film in this series is an array of the wounds of entry and exit. An "entry" column is arranged on the left of the film and the "exit" column on the right. Numbers appearing beside specimen images correspond to the assignment of gunshot wound numbers indicated in the autopsy protocol. Entry No. 1 is a view in which the superior portion of the image represents merely the integumental free surface and the remainder represents subcutaneous tissue. The specimen designated to include Entry No. 2 and Entry No. 3 is oriented on the film such that the radiation enters at the free surface of the skin. Orientation of this specimen takes into account the previously placed (at time of autopsy) suture nearest Entry No. 2. A faint image of this identifying suture is seen in this radiograph. Exit No. 2 is taken with the same orientation as the tissue including Entries 2 and 3.

Technical data for radiographs of wounds of entry and exit: 90 KV, 100 MA and 1/2 second exposure. The film suggested by Drs. Scanlan and Camp and used for these studies was Eastman Industrial type, affording superior contrast and resolution.

The above studies having been completed and all films processed and dried, the undersigned left The Hospital of The Good Samaritan at 7:25 P.M., to take the above items to the Hall of Justice. Colonel Finck had previously left the hospital (at 7:00 P.M.) for the purpose of returning the brain and other specimens (excluding the tissues containing wounds of entry and exit) to the Office of The Chief Medical Examiner-Coroner for further evaluation by the Neuropathologist. The undersigned returned the gunshot wound specimens to the office, along with the above described films.

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REPORT OF CHEMICAL ANALYSIS

COUNTY OF LOS ANGELES MEDICAL EXAMINER-CORONER
Toxicology Laboratory
Hall of Justice
Los Angeles, California

File No. 68-5731

Name of Deceased Senator Robert F. Kennedy Lab. No. 6-161

Date Submitted June 6, 1968 Time 8 A.M.

Autopsy Surgeon T. T. Noguchi, M.D.

Material Submitted:

Blood X	Liver X	Stomach
Brain	Lung X	Lavage
Femur	Spleen	Urine
Kidney	Sternum	Gall bladder
Drugs	Chemicals	

Test Desired: General Toxicological Analysis

Laboratory Findings:

A general toxicological analysis was performed on blood, liver and lungs. Nothing significant could be detected.

Examined By R. C. Gupta, Ph.D. Head Toxicologist. Date June 14, 1968

REPORT OF MICROBIOLOGICAL ANALYSIS
CHIEF MEDICAL EXAMINER-CORONER'S OFFICE

Bacteriology Laboratory
Hall of Justice
Los Angeles, California

File No. 68-5731

Name of Deceased Robert F. Kennedy

Date Submitted June 6, 1968

Autopsy Surgeon Thomas T. Noguchi, M.D.

Material Submitted Blood for ABO and Rh Typing.

Laboratory Findings: BLOOD: Group A1 Rh positive.

Roderick I. Luke

Examined By Roderick I. Luke Date June 12, 1968

5. There is a pair of navy blue, nearly calf length ocks of mixed cashmere and apparently nylon fiber, the fiber content stencil labeling still being nearly discernible on the foot portions.

6. There is a pair of white broadcloth boxer type shorts with two labels: "Sunsheen Broadcloth V' Cloth - 34"; and "Custom fashioned for Lewis and Thos. Saltz, Washington". There is a small amount of blood stain at the anterior crotch, along with pale straw-colored discoloration to the left of the fly. A few patches of dry blood are present on the back as well.

7. There is a trapezoidally folded cotton hankerchief showing, on what appears to be the presenting (anterior) surface, several scattered dark red and somewhat brown spots ranging from a fraction of a millimeter to about 4 mm (less than 3/16 inch) in greatest dimension.

8. No shoes are submitted for examination.

The above listed items are saved for further and more detailed study by others.

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GENERAL EXTERNAL EXAMINATION:

The non-embalmed body, measuring 70-1/2 inches (179 cm) in length and weighing about 165 pounds (74.5 kg), is that of a well-developed, well-nourished and muscular Caucasian male appearing about the recorded age of 42 years. The extremities are generally symmetrical bilaterally, showing no obvious structural abnormality.

The head shows extensive bandaging, somewhat blood-stained in the posterior aspect. Dressings are also present in the right clavicular region, the right axilla, and the right ankle regions. Also present over the right inguino-femoral region are apparently elastoplast dressings. A recent tracheostomy has been performed at a comparatively low level. A clear plastic tracheostomy tube fitted with an inflatable cuff is in place. The area also shows a gauze dressing.

Lividity is well developed in the posterior aspect of the body, mainly at the upper shoulder and midback regions with approximately equal distribution bilaterally. The lividity blanches definitely on finger pressure.

Rigor mortis is not detected in the extremities or in the neck.

> (Rigor was noted to be developing in the arms and legs by the time of conclusion of the autopsy.)

A complete examination of the external surfaces of the body is undertaken following removal of all dressings.

The head contour is generally symmetrical, due allowance being made for the soft-tissue edema and hemorrhage in the right post-auricular region in general. The hair is graying light brown and of male distribution. Portions of the right half of the scalp have been clipped and/or shaved. Hair in the inguinal and femoral regions has also been shaved in part. Hair texture is medium.

There is an irregularly bordered area of comparatively recent yet pale ecchymosis centered about one inch (2.5 cm) above the midportion of the right eyebrow. Marked ecchymosis with moderate edema is present in the right periorbital region but mainly of the upper eyelid. No abnormality is noted in the left periorbital tissue externally. No hemorrhage or generalized congestion is seen in the conjunctival or scleral membranes. The nose is symmetrical, showing no evidence of fracture or hemorrhage. The glabella shows no evidence of trauma.

Eye color is hazel. Pupillary diameters are equal at about 5 mm (3/16 inch).

The buccal mucosa and the tongue show no lesion.

Chest diameters are within normal limits and there is bilateral symmetry. The breasts are those of a normal adult male. The abdomen is scaphoid. No abdominal scar is identified. There is an old low medial inguinal scar on the right.

Texture and configuration of the nails are within normal limits, and no focal lesions are noted. There is no peripheral edema.

The skin in general shows a smooth texture and no additional significant focal lesion. There is abundant suntan, especially at the neck region where its contrast with the areas shaved for surgical preparation on the right can be noted.

No structural abnormality is noted on the back.

There is a diagonally disposed recent surgical incision about 3 inches (7.5 cm) in length in the right anterolateral femoral region. This incisiin has been intactly sutured. There is an associated plastic tubing of small diameter, centered about 1/2 inch (12 mm) from the infero-medial margin of the incision.

Also noted in a comparable location on the left are several hypodermic puncture marks. These just mentioned areas show the presence of red-orange dye.

There are recent cutdowns at the right ankle and the lateral right knee with thin polyethylene tubes in place. No extravasation is noted.

The external genitalia are those of a normal circumcised adult male.

CAVITIES:

Primary incision is first made as far as the two upper incisions, allowing upward reflection of skin and soft tissue to afford access for carotid angiography before the head is opened. Following completion of these roentgenographic studies, the traditional Y incision is continued. The peritoneal surfaces are smooth and glistening. No free fluid is found, in the abdominal cavity. There are no adhesions. Abdominal organs are in their usual relative positions.

The pleural surfaces are smooth. There is no pleural effusion.

The pericardium is intact and encloses a small amount of transparent straw-colored liquid.

CARDIOVASCULAR SYSTEM:

The heart weighs 360 gms. and presents smooth epicardial surfaces. There is moderate right atrial dilatation. The contour otherwise is within normal limits. Cut surfaces of myocardium show a uniform gray-red muscle fiber texture with no focal lesion. The endocardial surfaces are smooth. About 50 ml. of dark red postmortem clot is present in the chambers collectively. No cardiac anomaly is demonstrated. The thickness of the left ventricular wall is up to 1.3 cm, and that of the right, 0.3 cm. Valve circumferences are: Tricuspid - 13, pulmonic - 8.5, mitral - 10.5, and aortic - 7 cm. There are no focal lesions. The coronary arterial tree arises in the usual sites and distributes normally. The coronary arteries are thin-walled and pliable, showing widely patent lumina. The aorta has a normal configuration and varies from 3.3 to 5.2 cm in circumference. The intimal surface of the aorta shows small and comparatively pale yellow atheromatous areas totaling no more than 10 percent of the area studied.

The lining of the inferior vena cava is smooth throughout. The distal end of the intravenous polyethylene catheter is noted at the level of the second lumbar vertebra and shows no evidence of thrombosis at the tip. Free flow is also demonstrated.

Other vessels studied are not remarkable, save where special descriptions are given elsewhere in this report.

RESPIRATORY SYSTEM:

The right lung weighs 490 gm.; the left, 330 gms. There is a moderate amount of wrinkling of the external surfaces, suggestive of atelectasis. Dusky discoloration is noted in the hypostatic portions bilaterally. The outer surfaces of the lungs are intrinsically smooth. Cut surfaces of the lungs disclose a few scattered areas of atelectasis, especially in the left lower lobe. There is mild edema throughout. Hypostatic congestion is noted in an estimated 30 percent of the total lung volume, approximately equally distributed bilaterally. In these hypostatic areas, there is probably patchy hemorrhage of the matrix as well. No areas of consolidation are identified. Non-congested portions of the lungs are comparatively pale tan in color. Anthracotic pigmentation is not excessive for the age of the subject.

A small amount of slightly pink frothy mucoid material is present in the bronchial tree, but no exudate. There is no evidence of aspiration of gastric content.

The hilar lymph nodes show no abnormality.

NECK ORGANS:

The pharyngeal and laryngeal mucosa shows no focal lesion. There are a few petechial hemorrhages of the epiglottis. Intrinsic musculature and soft tissues of the larynx shows no hemorrhage or other evidence of trauma. The vocal cords do not appear edematous, nor is there evidence of generalized submucosal edema. The hyoid bone is intact.

The trachea is in midline. The plastic tracheostomy tube previously mentioned shows no obstruction of its airway and no exudates or hemorrhagic material. The mucosa lining the trachea is moderately injected at the general level of the tracheostomy, again with no obvious exudate.

The thymus is comparatively fatty but not otherwise remarkable.

HEPATOBILIARY SYSTEM:

The liver weighs 1810 gm. and has a smooth intact capsule. The edges are sharp. Cut surfaces of the liver show no focal lesion in the comparatively dark brown matrix. Little blood wells up from the freshly cut surfaces. A number of normal sized portal veins present themselves. There is no evidence of fibrosis. No fatty sheen is seen on the cut surfaces.

The gallbladder has a wall of average thickness and a smooth serosal surface. The organ is distended by the presence of more than 25 ml of green-black bile of intermediate viscosity. There are no calculi. The extra-hepatic biliary system is patent.

HEMIC AND LYMPHATIC SYSTEM:

The 150 gm. spleen is moderately firm and has a smooth intact capsule. Multiple cut surfaces of the spleen shows no focal lesion in the dark gray-red matrix. The capsule shows no areas of thickening. The malpighian bodies are distinct. No accessory spleen is identified.

There is no evidence of marked departure from normal blood volume. In areas where postmortem clot is found, this is of uniformly normal degree and texture. No evidence of any hemorrhagic diathesis is noted.

The abdominal lymph nodes, mainly the para-aortic, show moderate enlargement (up to three times the normal size) but no induration or focal change. Other lymph nodes studied are not remarkable.

PANCREAS:

Configuration and size are within normal limits. Multiple cut surfaces show no evidence of an acute inflammatory change, fatty necrosis, scarring, or hemorrhage.

UROGENITAL SYSTEM:

The right kidney weighs 180 gm. and has a smooth capsule which strips readily. Cut surfaces disclose normal corticomedullary ratios, with an average cortical thickness of about 6 mm, compared with 1.0 cm of the medulla. There are no focal lesions. A moderate amount of engorgement is noted.

The left kidney weighs 175 gm. and has a generally smooth capsule which can be stripped readily. Also present, however, is a retention cyst about 2.5 cm. in greatest dimension but showing on subsequent study, a principal volume delineated by a space 2.0 x 1.8 x 1.5 cm. Thin watery liquid is enclosed. About 3.0 cm from one pole of the left kidney and 2.0 cm. from the pelvis, is a well-circumscribed and slightly raised subcapsular nodule having a uniform yellow matrix and measuring 1.0 x 0.9 x 0.9 cm overall. The cut surface of this yellow nodule protrudes slightly. The lesion is about 6.0 cm from the just described retention cyst. Intervening matrix of the left kidney shows no focal change. The renal pelves of both kidneys and both ureters show no induration, dilatation, or exudates. Ureteral implantation is noted to be normal in the urinary bladder. About 8 ml of faintly amber-pink cloudy urine is contained. There is no focal lesion of the urothelial lining. There are no urinary calculi.

The prostate is symmetrical with a transverse diameter of 3.5 cm. Cut surfaces show no distinct nodular areas and no focal lesion. There are scattered areas of vascular engorgement near the origin of the prostatic urethra. A slightly gritty texture is found on the cut surfaces of the prostate. Scattered discrete calculi up to 2 mm in diameter are found.

The seminal vesicles are of normal configuration and contain a small amount of green-gray mucoid material.

Both testes are present in the scrotal sac and are of normal size and consistence. Tubular stringing is readily accomplished. No evidence of hydrocele is present.

DIGESTIVE SYSTEM:

The esophagus is lined by smooth pale-gray epithelium following the usual longitudinal folds. No focal lesion is found. The stomach has a wall of average thickness and a smooth serosal surface. There is mild gaseous dilatation. No evidence of hemorrhage or ulceration is found in the gastric mucosa. Within the lumen is about 500 ml of cloudy gray watery mucoid material in which no discrete food fragments are found. The duodenum, small intestine, and colon show no gross abnormalities of mucosal or serosal elements. The appendix is not identified. The mesenteric lymph nodes are not remarkable.

ENDOCRINE ORGANS:

The pituitary is intrinsically symmetrical and within the normal limits of size, as is the sella turcica.

The thyroid is symmetrical and not enlarged; cut surfaces of the brown-red colloid matrix shows no focal change.

The adrenals total 13.5 gm and are of normal configuration. Multiple cut surfaces show no focal lesion. The thickness of the cortex is little more than one millimeter. The medullary tissue is not remarkable.

MUSCULOSKELETAL SYSTEM:

The bony framework is well developed and well retained. No evidence of a diffuse osseous lesion is found. The fracture of the right orbital plate and of other components of the base of the skull are described in detail elsewhere in this report, mainly the neuropathology section. No additional evidence of recent fracture or other focal trauma is demonstrated in the skeleton.

The clinically described and radiologically documented old fractures are not dissected.

The vertebral marrow is a uniform brown-red, showing no focal change.

Cut surfaces of muscles studied, in areas apart from the trauma,show no abnormality.

SPECIMENS STUDIED:

Organ and body fluids enumerated elsewhere in this report for the purpose of toxicological examinations.

GENERAL TOXICOLOGICAL ANALYSES:

Nothing significant could be detected in a "General Unknown" analysis performed on blood, liver and lung tissue.

MICROSCOPIC STUDIES:

Tissue sections for microscopic examination as denoted in other portions of this report.

BLOOD TYPING:

Group A_1, Rh positive.

RADIOLOGICAL EXAMINATIONS:

Radiographs of the entire body were made at the time of autopsy. Subsequent radiographic studies are described elsewhere in this report.

PHOTOGRAPHS IN CUSTODY OF THIS OFFICE:

At autopsy: 35mm Kodachrome transparencies and prints of dissection and study of pertinent external and internal anatomic features.

At-scene investigation: Ambassador Hotel: 35mm Kodachrome transparencies and prints.

At test firings: 35mm Kodachrome transparencies and prints.

Special studies under our direction: Infra-red and panchromatic photographs by James Watson, Scientific Investigation Division, Los Angeles Police Department.

Prints of certain photographs by other jurisdictions, for corroborative studies by this office.

TTN:JEH:etf

AUTOPSY CHRONOLOGY AND PERSONNEL:

AUTOPSY:

Place:	The Hospital of The Good Samaritan Medical Center 1212 Shatto Street Los Angeles, California 90017
Date and Time:	June 6, 1968. Shortly before 3:00 A.M., the Chief Medical Examiner arrived at the hospital and took charge of the case. Autopsy commenced at 3:00 A.M. The body was released from custody at 9:15 A.M. the same date.

COUNTY OFFICIAL IN CHARGE OF MEDICOLEGAL INVESTIGATIONS:

Thomas T. Noguchi, M.D.
Chief Medical Examiner-Coroner
County of Los Angeles

AIDE IN CHARGE OF INTER-AGENCY RELATIONS:

Herbert McRoy
Administrative Deputy, Coroner

PATHOLOGISTS:

Thomas T. Noguchi, M.D.
Chief Medical Examiner-Coroner

John E. Holloway, M.D.
Deputy Medical Examiner

Abraham T. Lu, M.D.
Deputy Medical Examiner (In Charge of Neuropathology)

RADIOLOGIST:

R. L. Scanlan, M.D., Chairman
Department of Radiology
The Hospital of The Good Samaritan Medical Center, and
Deputy Medical Examiner.

Postmortem radiographs taken under the direction of the Chief Medical Examiner with assistance of Dr. Scanlan and his staff.

MEMBERS OF NEUROSURGICAL TEAM PRESENT AS OBSERVERS:

Henry M. Cuneo, M.D., Neurosurgeon in Charge
Nat D. Reid, M.D.
M. Andler, M.D.
James Poppen, M.D.

PATHOLOGIST FROM THE HOSPITAL OF THE GOOD SAMARITAN PRESENT AS OBSERVER:

J. A. Kernen, M.D.

CONSULTANTS FROM THE ARMED FORCES INSTITUTE OF PATHOLOGY:

Pierre A. Finck
Colonel, MC, USA
Chief, Military Environmental Pathology Division and
Chief, Wound Ballistics Division

Charles J. Stahl, III
Commander, MC, USN
Chief, Forensic Pathology Branch and
Assistant Chief, Military Environmental Pathology Division

Kenneth Earle, M.D.
Chief, Neuropathology Branch

FORENSIC AND MEDICAL PHOTOGRAPHERS:

John E. Holloway, M.D.
Deputy Medical Examiner

Richard Kottke
Deputy Coroner

Charles Collier
Scientific Investigation Division
Los Angeles Police Department

IN CHARGE OF SECURITY OF AUTOPSY ROOM, FOR THE OFFICE OF THE CHIEF MEDICAL EXAMINER-CORONER:

Charles Maxwell
Chief of Investigation Division

AUTOPSY ASSISTANT:

Edward Day
Senior Investigator

DESCRIPTION OF PRE-OPERATIVE X-RAYS

Anteroposterior and lateral portable films of the skull, exposed on June 5, 1968 at approximately 1:00 A.M., reveal a gunshot wound of the right temporal bone. The wound of entry is 2.0 cm above the temporal tip and approximately midway between the external auditory canal and the sigmoid sinus region, approximately 1.0 cm posterior to the auditory canal.

Emphasis LC

There are two bullet tracks. One extends slightly anterior to the vertical dimension (15 degrees). The second extends 30 degrees posterior to the vertical dimension, so that the two tracks diverge 45 degrees.

In the frontal projection, both tracks extend superiorly toward the vertex at an angle of 30 degrees to the horizontal.

In the tracks of the bullet wound are numerous metallic foreign bodies and fragments of the mastoid. The largest metallic fragment is situated in the petrous ridge and at about the arcuate eminence. This measures 12 mm in transverse dimension,* 7 mm in vertical dimension, and approximately 12 mm in anteroposterior dimension.

Several metallic foreign bodies are present in the soft tissues lateral to the mastoid process. Twelve metallic foreign bodies, one millimeter or larger, are present in the mastoid process. In addition to the largest fragment described, at least thirty metallic fragments one millimeter or larger are present in the posterior fossa.

One fragment of bone and several metallic fragments projected through the orbit above the petrous ridge are, I believe, supratentorial, and in the mesial aspect of the temporal lobe posteriorly.

A fragment, 7 mm in transverse diameter, 4 mm in greatest anteroposterior dimension and vertical dimension, is situated superiorly slightly to the left of the midline and 4.0 cm anterior to the inner cortex of the occipital bone at or just below the tentorium.

The main fragments of the bullet are anterior to the sigmoid sinus as seen in the lateral projection, and this includes the major bony fragment as well.

Caliber = diameter of bullet in hundredths of an inch
1 MM = .03937 inch 12 MM = .47244 inch
12 mm diameter bullet = .47 caliber bullet
LC

DESCRIPTION OF POSTMORTEM RADIOGRAPHS

Postmortem radiographs exposed at 2:00 A.M. to 3:00 A.M., under the direction of the Chief Medical Examiner-Coroner, on June 6, 1968, reveal that a major portion of the petrous ridge has been removed, together with most of the metallic foreign bodies and the detached osseous fragments.

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* Excerpt from Pages 38 + 39 - "Special Unit Senator" by Robert A. Houghton, Chief of Detectives, LAPD "Chips of bone, clotted blood, bruised brain tissue and lead fragments were removed by Dr. Cuneo. Dr. Nat S. Reid also removed a piece of bullet some 12 millimeters in diameter and other fragments of lead easily identified as having come from a bullet."
LC

At this time, the metallic fragment most superior and posterior has shifted slightly posteriorly and to the right.

Small fragments remain in the soft tissues lateral to the temporal bone, numbering approximately eleven and very minute. Other fragments, approximately seven in number, are situated directly above the petrous apex and, I believe, supra-tentorial, in the temporal lobe. This represents the remains of the largest metallic fragment noted pre-operatively. Other minute fragments are present in the posterior fossa, numbering approximately twenty.

All of the bony fragments have been removed.

X-rays of the skull at the conclusion of the postmortem revealed that five minute metallic foreign bodies were present in the skin, and approximately twenty minute fragments remained embedded in the remaining portion of the temporal bone in the region of the semicircular canals.

DESCRIPTION OF SPECIMEN RADIOGRAPHS OF SURGICAL BONY SPECIMEN

A series of x-ray films was obtained on June 7, 1968 between 4:00 P.M. and 7:30 P.M.

The initial x-rays consisted of the fragments of temporal bone removed at surgery. These were exposed on industrial film-type M (Kodak) and reveal many more minute metallic foreign bodies than were evident on the early films. Pieces of bone identifiable as mastoid process are filled with approximately seventy individual metallic fragments. Others bearing the Rongeur marks are fragments of cortex removed at surgery from the craniotomy site. Other fragments represent petrous ridge and are also embedded with innumerable fine metallic particles.

The specimen of temporal bone removed at postmortem includes the craniotomy site and the remaining portion of the mastoid process extending posteriorly to include the lateral sinus groove and the facial canal distally. Mesially, the bone is amputated lateral to the cochlea. This contains the external auditory canal. Posterior and superior to the canal are many metallic fragments. These number at least sixty, the majority less than one millimeter in size, with ten above one millimeter.

DESCRIPTION OF SPECIMEN X-RAYS EXPOSED AT THE GOOD SAMARITAL HOSPITAL (Friday, June 7, 1968)

X-rays of the entire brain, taken initially in the vertex-base direction, reveal small metallic foreign bodies in the cerebellum and temporal lobe. There is a considerable defect of the cerebellum on the right. A small amount of residual contrast (Hypaque) is present in the arterial tree in the left temporal area.

Following the above, the individual sections were x-rayed and labeled respectively: A for the tips of the frontal lobes and successively posteriorly at 2.0 cm intervals, B; C (which includes the anterior aspect of thetemporal lobes); and D; etc. E shows one metallic foreign body in the right temporal lobe, plus a defect in the mesial aspect of the temporal lobe in the region of the uncal gyrus. Residual contrast is in the choroid plexus of the lateral ventricle on the left.

Specimen labeled F consists of slice F plus the separate specimen F-1 from the temporal lobe, which contains ten minute metallic foreign bodies in one segment and three minute ones in another area. The cerebellum is also present which reveals a large defect and twenty minute metallic foreign bodies. The specimens of the brain, G and H, extending to the occipital pole, reveal no abnormality.

Separate x-rays were performed on specimen F and F-1 and the cerebellum, plus x-rays of the meninges. The meninges are tattooed with many metallic foreign bodies surrounding the defect; which is in the region of the original wound of entry.

These number fully fifty, with all but three or four under one millimeter in diameter.

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DESCRIPTION OF SKIN AND HAIR X-RAYS

X-rays of 68-5731 obtained at the Good Samaritan Hospital between 1:00 and 3:00 P.M., Saturday, June 8, 1968.

The right ear is portrayed in profile and en face. The profile shows the skin surface directed away from the identifying number. The larger side of the ear specimen is to the right in both projections.

Tattooed in the skin are many small metallic foreign bodies. Other foreign bodies are present in the ear which do not appear to be metallic.

Gunshot Wound No. 1 was examined in profile with the cutaneous surface directed toward the number. Two fragments of the wound are present. Both reveal metallic foreign bodies of varying size from barely visible to 1 mm in diameter in the subcutaneous tissue. Many minute foreign bodies are present in the skin superficially surrounding the wound of entry. These resemble in size the particles seen in the ear.

The skin of Gunshot Wound No. 2 and Gunshot Wound No. 3 also reveals the superficial dense metallic impregnation of the skin with several metallic foreign bodies in the subcutaneous tissue. These specimens are also arranged in profile with the cutaneous surface extending toward the identifying number.

The third examination is of the scalp hair obtained prior to surgery. In this area, many dust-like metallic particles are evident, varying in size but all extremely small and differing appreciably from the several artifacts noticed to the left of the label "scalp hair" on the superior aspect of the film.

Three metallic particles are noted in the hair obtained at autopsy. Two of these are extremely minute and one is approximately .5 mm in diameter.

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DESCRIPTION OF X-RAYS OF SKIN WOUNDS

X-rays were obtained of the skin wounds, which are labeled 1, 2, and 3.

GUNSHOT WOUND NO. 1:

A profile view of the skin surrounding wound of entry in the right mastoid area reveals a few metallic foreign bodies superficially and other larger foreign bodies (1 cm.) in the subcutaneous tissue.

GUNSHOT WOUNDS NOS. 2 AND 3:

A frontal projection of the axillary skin surrounding wounds labeled 2 and 3 reveals fine metallic foreign bodies in both these situations.

The wound of exit is placed in profile. Wound 2 reveals two minute metallic foreign bodies barely visible in the subcutaneous tissue below the wound.

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HEAD AND NERVOUS SYSTEM (Generally):

Also revealed by the reflection of the scalp is a fairly well demarcated area of non-recent hemorrhagic discoloration, about 1.5 cm in greatest dimension, in the left parietal occipital region. No associated galeal hemorrhage is demonstrated.

The cerebrospinal fluid is blood tinged.

Abundant and freshly clotted but drying blood is found at the right external auditory canal, extending outward to the lateral interstices of the external ear. No evidence of hemorrhage is found at the left ear.

The spinal cord is taken for further evaluation. At the time of removal of the cord, a small amount of cervical epidural hemorrhage is noted. There is no evidence, on preliminary inspection, of avulsion of roots leading to the right brachial plexus.

Those portions of peripheral nervous system exposed by the described dissection show no abnormality.

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GUNSHOT WOUND NO. 2:

This is a through-and-through wound of the right axillary, medial shoulder, and anterior superior chest areas, excluding the thorax proper. The wound of entry is centered 12-1/2 inches (31.8 cm) from the vertex, 9 inches (22.9 cm) to the right of midline, and 3-3/4 inches (8.3 cm) from the back (anterior to a coronal plane passing through the surface of the skin at the scapula region). There is a regularly elliptical defect 3/16 x 1/8 inch over-all (about 0.5 x 0.3 cm) with thin rim of abrasion. There is no apparent charring or powder residue in the adjacent and subjacent tissue. The subcutaneous fatty tissue is hemorrhagic.

The wound path is through soft tissue, medially to the left, superiorly and somewhat anteriorly. Bony structures, major blood vessels and the brachial plexus have been spared.

The exit wound is centered 9-3/4 inches (about 24.5 cm) from the vertex and about 5 inches (about 12.5 cm) to the right of midline anteriorly in the infraclavicular region. There is a nearly circular defect slightly less than 1/4 inch x 3/16 inch overall (0.6 x 0.5 cm).

Orientation of the wounds of entry and exit is such that their major axes at the skin surfaces coincide with the central axis of a probe passed along the entirety of the wound path. No evidence of deflection of trajectory is found.*

MICROSCOPIC EXAMINATION OF THE SLIDE LABELED GUNSHOT WOUND NO. 2 (GSW #2) ENTRANCE WOUND.

The perpendicular sections of the gunshot wound show cellular degeneration of the margins of the covering epithelium. The dermis shows extensive coagulation, early cell infiltration by mostly neutrophiles, and hemolyzed and relatively intact erythrocytes. The area of coagulation necrosis includes disintegration of apparently sweat and sebaceous gland. Only remnants are visualized.

Gunpowder granules embedded into the dermis and the surface of the gunshot wound track are visible on stained and unstained sections.

The subcutaneous and adipose tissue shows extensively extravasated hemorrhage.

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* Excerpt from Page 21 - Grand Jury Testimony - 6/7/68

NOGUCHI: "...only it was impossible for me to trace the (#2) gunshot wound track straight unless I could place the Senator's right arm forward"

L.C.

GUNSHOT WOUND NO. 3:

The wound of entry is centered 14 inches (35.6 cm) from the vertex and 8-1/2 inches (21.6 cm) to the right of midline, 2 inches (5 cm) from the back anterior to a plane passing through the skin surface overlying the scapula, and 1/2 inch (1.2 cm) posterior to the mid-axillary line. There is a nearly circular defect 3/16 inch by slightly more than 1/8 inch overall (0.5 x 0.4 cm). There is a thin marginal abrasion rim without evidence of charring or apparent residue in the adjacent skin or subjacent soft tissue. The subcutaneous fatty tissue is hemorrhagic.

The wound path is directed medially to the left, superiorly and posteriorly through soft tissue of the medial portion of the axilla and soft tissue of the upper back, terminating at a point at the level of the 6th thoracic vertebra as close as about 1/2 inch (1.2 cm) to the right of midline.

?CERVICAL? (R.H)
DC.

Bullet Recovery:

A deformed bullet (later identified as .22 caliber) is recovered at the terminus of the wound path just described at 8:40 A.M., June 6, 1968. There is a unilateral, transverse deformation, the contour of which is indicated on an accompanying diagram. The initials, TN, and the numbers 31 are placed on the base of the bullet for future identification. The usual evidence envelope is prepared. The bullet, so marked and so enclosed as evidence, is given to Sergeant W. Jordan, No. 7167, Rampart Detectives, Los Angeles Police Department, at 8:49 A.M. this date for further studies.

An irregularly bordered and somewhat elliptical zone of variably mottled recent ecchymosis is present in the superior-medial axillary skin on the right, in the zones of wounds of entry No. 2 and No. 3, especially the former. The ecchymosis measures 3-1/2 x 1-1/2 inches (9 x 3.8 cm) overall with the right upper extremity extended completely upward (longitudinally).

TRIANGULATION OF GUNSHOT WOUNDS

Angles and planes refer to the body considered in the standing position, in accordance with usual anatomic custom.

GUNSHOT WOUND #1

Goniometric studies by Dr. Scanlan are described by him elsewhere in this report. Photographs of internal features of the skull are confirmatory.

GUNSHOT WOUND #2

Autopsy measurements indicate an angle of 35 degrees counterclockwise from the transverse plane as viewed frontally. Triangulation measurements from photographs give an angle of 33 degrees.

Autopsy measurements indicate an angle of 59 degrees counterclockwise from the transverse plane as viewed laterally from the right. Measurements from photographs also indicate an angle of 59 degrees.

Autopsy measurements indicate an angle of 25 degrees measured clockwise from the coronal plane (anteriorly) as viewed from the vertex.

GUNSHOT WOUND #3

Autopsy measurements show an angle of 30 degrees upward from the transverse plane, counterclockwise as viewed frontally. Photographic studies also show an angle of 30 degrees.

Autopsy measurements show an angle of 67 degrees clockwise from the transverse plane as viewed laterally from the right. Photographs indicate an angle of about 70 degrees.

Measurements indicate an angle of 5-1/2 degrees counterclockwise and behind the coronal plane as viewed from the vertex. The photographs are in agreement for this small angle.

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EXAMINATION OF CLOTHING AT THE TIME OF AUTOPSY:

1. There is a dark blue, fine worsted-type suit coat bearing the label "Georgetown University Shop - Georgetown, D.C.". The coat has been cut and/or torn at the left yoke and left sleeve area. The right sleeve is intact. There is variable blood staining over the right shoulder region and on the right lapel. Two apparent bullet holes are identified in the right axillary region, slightly over 1 inch (2.5 cm) and slightly over 1-1/4 inch (3.2 cm) from the underseam area, respectively, and corresponding with wounds described on the body elsewhere in this report. Also noted at the top of the right shoulder region centered about 1-1/4 inches from the shoulder seam and about 5/8 inch (1.6 cm) posterior to the yoke seam superiorly is an irregular rent of the fabric, somewhat less than 1/4 inch (3.2 cm) in diameter and definitely everting superficially and upward. The three front buttons of the garment are intact.

   (Subsequent examination of the coat showed the presence of a superficial through-and-through bullet path through the upper right shoulder area, passing through the suit fabric proper, but not the lining.)

2. There is a pair of trousers of matching material with a very dark brown leather belt with rectangular metal buckle and showing the gold-stamped label "Custom Leather, Reversible, 32". The zipper is intact. There is a minimal amount of apparent blood staining over the anterior portions of the trouser legs.

3. There is a white cotton shirt with the label "K WRAGGE, 48 West 46th Street, New York". The laundry mark initials "RFK" are present on the neck band. The left portion of the shirt has been disrupted in approximately the same manner as the suit coat and is similarly absent. The right cuff is intact and is of semi-French design. A chain-connected yellow metal cufflink with plain oval design is in place. A corresponding left cufflink is not among the items submitted. Apparent bullet holes are identified as corresponding to those in the previously described area of suit coat.

4. There is a tie of apparent silk rep, navy blue with an approximately 3/16 inch (0.5 cm) grey diagonal stripe. The label is "Chase and Collier, McLean, Virginia". The maker is RIVETZ.

film of blood up to 3 mm thick, covering the arachnoid over both posterior frontal and parieto-occipital regions and extending downward to, and in some places below the sylvian fissure bilaterally, slightly more on the left side than on the right. Similar blood clot is also found on the left middle fossa and in both posterior fossae, again more on the left side. A small amount of blood clot, about 2 cc, is found between the cerebral hemispheres just dorsal to the midbrain.

Rather diffuse subarachnoid hemorrhage is present over the parieto-occipital regions, over the dorsal and right side of the cerebellum and also over the ventral surface of the pons and medulla. All of this, however, is quite slight and the blood clot does not obscure the underlying structures.

Epidural hemorrhages are found in the following three locations:

1. Adjacent to the craniotomy defect of the right temporo-occipital region. This is minimal and extends not more than 1 cm from the surgical incision and it is less than 1 mm in thickness.

2. Above the right supraorbital plate where the fracture is present as described above. This is deemed minimal and less than 1 mm in thickness covering an area 1.5 x 1 cm.

3. Epidural hemorrhage measuring 2 cm longitudinally and 1 cm transversely is found in the dorsal aspect of the epidural space at C1 and C2 vertebral levels.

The dorsal veins which empty into the superior saggital sinus are inspected but they reveal no evidence of the source of subdural hemorrhage.

The right superior petrosal sinus is severed for a distance of 8 mm corresponding to the defect of the petrous ridge mentioned above. The remainder of this sinus adjacent to the defect has been cauterized. The tentorium which has its attachment to the right petrous ridge is lacerated where the bony defect is present. This laceration of the dura is continued laterally and communicates with the surgical defect which measures 4.5 x 2.0 cm just anterior to the right sigmoid sinus and above the transverse sinus beneath the craniotomy opening. A second surgical defect is present on the dura posterior to the sigmoid sinus and inferior to the transverse sinus and this measures 3 x 2 cm. There are areas of brownish discoloration and a minimal amount of blood clot is scattered along the margins of these dural openings.

The lateral portion of the transverse sinus and the sigmoid sinus thus transverse the craniotomy defect horizontally through its posterior portion and vertically through its inferior portion.

The tentorium cerebelli shows no defects in its central portions.

The dura was lacerated over a small area over the right supra-orbital plate where a curved fracture was present as mentioned above.

The superior saggital sinus, left transverse sinus, left sigmoid sinus and cavernous sinuses are inspected and reveal no evidence of thrombosis or laceration. The right transverse and sigmoid sinuses do not appear to be damaged in spite of their proximity to the dural openings anterior and posterior to it, but cautery marks are on and close to these sinuses which contain dark red blood clot.

Examination of the arteries of the brain stem and cerebellum reveals a right vertebral artery that is smaller than the left. The basilar artery measures 3 mm in diameter and is slightly tortuous. The anterior inferior cerebellar arteries and the posterior inferior cerebellar arteries have a normal distribution and show no evidence of traumatic injury. The left superior cerebellar artery is intact. The right superior cerebellar artery is intact throughout its main trunk but several of its superficial branches are involved in the cortical contusion and laceration of the cerebellum and many of its deeper branches have been damaged by the penetrating bullet and bone fragments.

All of the remaining blood vessels of the brain stem, cerebellum and cerebral hemispheres have normal distribution and show very slight atherosclerosis. There is no evidence of injury except for the areas of contusions and lacerations.

The cranial nerves are all intact.

C. Cerebrum.

Slight depression of the cerebral cortex is noted over both posterior frontal and parietal convexities in the areas beneath the subdural hemorrhage that is described above. The right cerebral hemisphere is slightly larger than the left with shallow tentorium grooves over both unci, slightly more prominent on the right than on the left. However, there is no evidence of herniation of the cingulate gyri beneath the falx. The gyri over both cerebral convexities are flattened.

When the brain is inspected from the ventral aspect, three areas of contusion-laceration can be seen in the cortex of the right cerebral hemisphere and a fourth area of contusion on the left. The largest one measures 4 x 3 cm. It consists of superficial and deep lacerations and contusions of the mesial half of the posterior one-third of the right inferior temporal gyrus for an anteroposterior distance of 4 cm; the middle third of the right fusiform gyrus for 3 cm and the lateral portion of the hippocampal gyrus for a distance of about 1 cm. Coronal sections show that this laceration has a subcortical hemorrhage extending 1.5 cm into the subcortical white matter to the floor of the posterior part of the temporal horn of the right lateral ventricle with rupture into this cavity. The medial portions of the temporal lesion are characteristic of laceration and contusion while the lateral portions of this lesion are quite characteristic of hemorrhagic infarction.

The second largest contusion is in the middle part of the right orbital gyri and measures 1.5 x 1.0 cm with a 5 mm curved laceration within it. Hemorrhage extends into the subcortical white matter to a depth of 6 mm. This lesion overlies the lacerated dura and fracture of the right supraorbital plate.

The third contusion measures 14 x 7 mm with a linear 6 mm transverse laceration and is situated in the mesial portion of the inferior part of the right occipital cortex.

The fourth contusion of the cortex is a very small lesion in the middle of the left inferior temporal gyrus and measures 5 x 2 mm. There is no laceration in this area. This condition is limited to the gray matter.

D. Cerebellum.

In the anterior and lateral aspects of the right hemisphere of the cerebellum, there is an irregular penetrating wound. The opening measures 2 x 2 cm with irregular margins. The margins of this wound and adjacent areas are elevated to form a ring of tissue at the bony margin, 2 mm distal to the internal bone surface. This indicates herniation of the cerebellar tissue into the bony defect. On the surface of this defect and in the bone incision, there are fragments of gelfoam and soft friable blood clots.

A partially collapsed linear tract measuring 5 cm in length extends from the cerebellar cortex and subcortical white matter of the cerebellum to the vermis. The tract begins just rostral to the tegmentum of the anterior one-third of the pons, anterior to the middle cerebellar peduncle and proceeds in a superior and posterior direction. From an imaginary transverse plane between the two mastoid bones, one would estimate that this tract proceeds about 45 degrees posteriorly and medially and 30 degrees superiorly from the mastoid perforation. The tract ends in the vermis of the cerebellum where a 1 cm transverse laceration is found in the region of the primary fissure which is approximately 3 cm posterior to the anterior cerebellar notch. At the termination of the tract, hemorrhage can be seen within the cortical laceration.

The size of the penetrating wound is difficult to determine at this time since the tract is largely filled by the swollen white matter of the cerebellum and by hemorrhage. However, probing into the tract at the entrance wound indicates that it was in the order of 2 cm in width at maximum expansion.

Upon palpation and probing in the region of the laceration in the superior vermis, a metallic fragment is found just beneath the arachnoid membrane and within an area of hemorrhage. This irregular gray metallic fragment measures 6 x 3 x 2 mm and corresponds to the largest fragment that was identified in the postoperative x-ray of a radiopaque object near the midline.

In addition to the penetrating wound and the laceration of the vermis at its terminal end, an area of contusion and hemorrhagic necrosis measuring 2.5 x 2.0 cm covers most of the superior surface of the right cerebellar hemisphere and extends 5 mm over the midline. Beneath this area of contusion and communicating with the penetrating wound, a recent hematoma is found that measures 2.5 x 2.0 cm. The hemorrhage involves the region of the declive, folium, and tuber. Smaller satellite contusions and hemorrhagic necrosis are scattered lateral to the large contusion of the superior surface of the cerebellum. Both cerebellar hemispheres are markedly swollen with flattened gyri and with a cerebellar pressure cone. Two small areas of hemorrhagic necrosis, each 3 mm in diameter, are present in the cortex of the herniated left cerebellar tonsil. The right cerebellar tonsil shows a single area of cortical hemorrhagic necrosis also 3 mm in diameter.

An elliptical groove over the superior surface of the anterior lobe of the cerebellum indicates upward herniation of these structures through the incisura of the tentorium cerebelli.

Horizontal sections of the cerebellum reveal the penetrating wound and the hemorrhage described above. These lesions have destroyed much of the cortex and subcortical white matter of the right cerebellar hemisphere, the dentate nuclei and probably the roof nuclei.

E. Brain Stem.

The ventral surface of the pons and medulla is markedly flattened.

The periaqueductal gray matter contains multiple petechial hemorrhages extending over an area of 8-9 mm in width on the left side and about 5 mm on the right side. In sections above the pons, the midbrain reveals several irregular hemorrhages within the tegmentum. The largest of these hemorrhages is slit-like and measures 5 x 1 mm in size and is situated in the left lateral tegmentum. Numerous petechial hemorrhages are found throughout both the tegmental and ventral portions of the rostral 3/4 of the pons on multiple horizontal sections. Section through the medulla shows an area of hemorrhagic necrosis 4 x 3 mm in diameter located in the left inferior olive.

F. Ventricular System.

The lateral and third ventricles are moderately narrowed in size. They contain a small amount of blood clot totaling about 6 cc. The source of the intraventricular hemorrhage is due to rupture into the right inferior horn of the hemorrhage of the right temporal lobe. The fourth ventricle also contains a small amount of fresh blood clots.

G. Spinal Canal and Spinal Cord.

The foramen magnum and the upper cervical vertebrae are inspected and they show no abnormalities.

The bodies of the lower cervical, thoracic and upper lumbar vertebrae are removed in a column. After inspecting the spinal nerve roots, the cervical, thoracic and lumbar spinal cord is removed in toto.

A 41-cm portion of the spinal cord extending from the high cervical region into the lumbar region is examined. The leptomeninges are thin and transparent. The anterior spinal artery is thin-walled and shows no evidence of occlusion or laceration.

The posterior aspect of the spinal cord additionally reveals thin leptomeninges and normal distribution of vessels and nerve roots. There is no evidence of pathologic damage to the spinal cord. The subarachnoid space shows faint blood staining. Multiple transverse sections of the spinal cord and nerve roots show no gross lesions.

H. Pituitary Gland.

The diaphragma sella and pituitary stalk are normal in appearance. The pituitary gland measures 1.1 x 0.8 x 0.5 cm. Section shows a pink homogeneous anterior lobe and a reddish gray posterior lobe. The bony structures forming and surrounding the pituitary fossa are all within normal limits.

MICROSCOPIC REPORT (NEUROPATHOLOGY)

There are 31 slides divided into three groups: A, B and C. Each group is again numbered as A-1, A-2, A-3, or B-1, B-2, B-3, B-4 and C-1, C-2, C-3, C-4, etc.

Sections confirmed all the lesions described at the gross examination.

All tissue sections show congestion and some extravasation with occasional actual petechial hemorrhages, the latter being particularly noticeable in the thalami near the ventricular walls. A few mononuclear cells are present in the perivascular spaces. The ground substance of the cerebral cortex and centrum shows fine vacuolations. In the occipital cortex, there is early status spongiosus, portions of which have a laminar distribution. Some nerve cells have pyknotic nuclei and homogenization of the cytoplasm, the latter showing definite eosinophilia. The white matter of the frontal lobe shows occasional areas of pallid staining. In the ventral pons there is early necrosis in addition to the hemorrhages.

A-1, RIGHT FRONTAL LOBE:

This section shows marked congestion of the meningeal and parenchymal blood vessels. The endothelium of the blood vessels shows hypertrophy. There is no inflammatory infiltrate in the meninges. There is a diffuse rarefaction of the matrix of the cortex and white matter, but more marked in the white matter where there are actual areas of early status spongiosus. Many of the nerve cells are pyknotic. The glial and ependymal elements are swollen.

A-2, LEFT FRONTAL LOBE:

Findings are similar to A-1, except that the status spongiosus of the white matter is not obvious.

A-3, RIGHT TEMPORAL LOBE - HIPPOCAMPUS:

Findings are similar to A-2.

A-4, LEFT TEMPORAL LOBE - HIPPOCAMPUS:

In addition to similar findings as in A-3, there are several small petechiae in the cortex. This section also shows slight subarachnoid hemorrhage.

A-5, RIGHT PARIETAL LOBE:

The general findings of these sections are similar to A-2. However, some nerve cells are not only pyknotic but they are also beginning to show eosinophilia of the contracted and homogenized cytoplasm.

A-6, LEFT PARIETAL LOBE:

This slide shows findings similar to A-2. In addition, there is subarachnoid hemorrhage.

A-7, RIGHT OCCIPITAL LOBE:

This section shows marked congestion of all the blood vessels with extravasation of blood in the white matter. The cortex shows early status spongiosus which has a suggestive laminar pattern.

A-8, LEFT OCCIPITAL LOBE:

This section shows findings similar to A-7 above. Some of the nerve cells are beginning to show eosinophilia of the cytoplasm.

A-9, RIGHT STRIATUM:

In general the blood vessels and nerve cells show changes of the cortex similar to those described in A-2. The subependymal blood vessels show a few mononuclear cells in the perivascular spaces. There is also some extravasation of blood from these vessels.

A-10, LEFT STRIATUM:

The findings are similar to A-9.

A-11, RIGHT LENTICULAR NUCLEUS:

The findings are similar to A-9 except the extravasation of blood is not obvious.

A-12, LEFT LENTICULAR NUCLEUS:

The findings are similar to A-11.

A-13, RIGHT THALAMUS:

These sections show generalized congestion and actual petechial hemorrhages in the walls of the third ventricle. The nerve cells show pyknotic changes. Portions of the matrix show early status spongiosus.

A-14, LEFT THALAMUS:

The findings are similar to A-13 but the petechial hemorrhages are not as marked.

A-15, -16, -17, and -18, SPINAL CORD:

Sections are taken from the cervical, thoracic and lumbosacral regions. The vascular changes in the meninges and spinal cord are minimal and certainly not as pronounced as those in the cerebrum. A few of the nerve cells in the grey matter, mostly in anterior horns, show pyknotic changes.

B-1, RIGHT TRANSVERSE SINUS:

Sections show red blood cells between the laminae of the dura. The sinus contains antemortem thrombus along the vessel walls. This thrombus consists mainly of platelets. In the remainder of the blood clot, there are numerous neutrophils.

B-2, RIGHT SIGMOID SINUS:

Portions of the dura show coagulation necrosis with tinctorial changes toward basophilia. Antemortem thrombus is also found in the sinus, as in B-1.

B-3, RIGHT FRONTAL LOBE - ORBITAL GYRI:

Sections show hemorrhagic necrosis of the cortex.

B-4, RIGHT TEMPORAL LOBE - PARAHIPPOCAMPAL AND FUSIFORM GYRI:

This section shows most extensive hemorrhagic defects, both in the grey and white matter. The defect communicates with the external surface. The remaining portions of the specimen show changes similar to A-2.

B-5, RIGHT TEMPORAL LOBE:

The findings are similar to B-4.

B-6, RIGHT OCCIPITAL LOBE, MEDIAL INFERIOR ASPECT:

Sections show superficial hemorrhagic defect of the cortex.

C-1, LEFT INFERIOR TEMPORAL LOBE:

This section shows multiple hemorrhagic necrosis in the cortex.

C-2, MIDBRAIN:

Section shows multiple hemorrhages. The cerebral aqueduct is patent.

C-3 AND C-4, PONS:

Sections show multiple hemorrhage, mostly in the ventral portions, and acute necrosis. The fourth ventricle is collapsed.

C-5, MEDULLA:

Focal hemorrhagic necrosis is present in the left inferior olive.

C-6, CEREBELLUM, DORSAL ASPECT:

This shows a large hemorrhagic defect with multiple petechial hemorrhages in portions of the dentate nucleus. In another portion of the dentate nucleus, where there is no hemorrhage, there is acute necrosis.

C-7, CEREBELLUM, TONSIL:

This shows multiple petechiae in the cortex.

ADDITIONAL MICROSCOPIC SLIDES (NEUROPATHOLOGY):

The Pineal Gland shows a few corpora amylacea.

Sections of the temporal lobe reveal essentially the same histopathological findings described previously.

SLIDE LABELED GUNSHOT WOUND [GSW #1], (Entrance Wound):

The perpendicular section,stained with hematoxylin and eosin, through the wound track shows loss of epithelium and patchy areas of swollen dermis.

The area of margins of squamous epithelium shows perinuclear vacuolation and spindle form distortion.

The dermis is extensively involved with coagulation also visible in special stain. The hair follicles and sebaceous glands are partly involved also. Capillaries are dilated. There are areas of extravasation and infiltration by acute inflammatory cells. Scattered, varying-sized powder residues are found in the keratin layer and the inner surface of the wound track to a depth of 2 mm. There are also disc-like powder granules embedded in the epidermis, and the powder-embedded area is surrounded by pink-staining denatured collagen. Powder residues are in an assortment of shapes and sizes, the edges showing minute crystalloid material which is also visible on the unstained sections.

Subcutaneous tissue and muscle elements are hemorrhagic and heavily infiltrated by neutrophils.

Microscopic Diagnosis:

Entry of the gunshot wound is consistent with very close range shooting.

SLIDE FROM POSTERIOR ASPECT OF HELIX OF RIGHT EAR, INCLUDING GROSSLY DESCRIBED POWDER SMUDGING AND TATTOOING:

The sections stained with hematoxylin and eosin show patchy areas of loss of epithelium due to thermal and blast effect. The squamous epithelium between the exposed coagulated dermis shows perinuclear vacuolation and nuclear elongation, along with fragmentation at the edges.

Dark brown to black powder residues in varying sizes are embedded through the epithelium to the dermis, which is also recognizable in unstained sections. The dermis shows extensive coagulation of the collagen tissue. Sweat glands and hair follicles, together with associated sebaceous glands, are involved with changes consistent with heat and blast effect. Coagulation of the collagen tissue is also visible on sections stained by Masson's method.

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COUNTY OF LOS ANGELES
DEPARTMENT OF CHIEF MEDICAL EXAMINER – CORONER
HALL OF JUSTICE, LOS ANGELES, CALIFORNIA 90012
THOMAS T. NOGUCHI, M. D.
CHIEF MEDICAL EXAMINER-CORONER

File 68-5731

This is to certify that the autopsy on the body of Senator Robert F. Kennedy was performed at The Hospital of The Good Samaritan, Los Angeles, California, by the staff of the Department of Chief Medical Examiner-Coroner on June 6, 1968.

From the anatomic findings and pertinent history, I ascribe the death to:

GUNSHOT WOUND OF RIGHT MASTOID, PENETRATING BRAIN.

The detailed medical findings, opinions and conclusions required by Section 27491.4 of the Government Code of California are attached.

Thomas T Noguchi, M.D.

Thomas T. Noguchi, M.D.
Chief Medical Examiner-Coroner

TTN:etf

FINAL SUMMARY

GUNSHOT WOUND NO. 1 (FATAL GUNSHOT WOUND)

ENTRY:	Right mastoid region.
COURSE:	Skin of right mastoid region, right mastoid, petrous portion of right temporal bone, right temporal lobe, and right hemisphere of cerebellum.
EXIT:	None.
DIRECTION:	Right to left, slightly to front, upward.
BULLET RECOVERY:	Fragments (see text).

LESIONS IN DETAIL (NEUROPATHOLOGY)

A. Primary lesions - Caused by the bullet and further injuries by bone and bullet fragments.

1. Bone, dura and dural sinus.
    a. Penetration of right mastoid process.
    b. Fracture of right petrous ridge.
    c. Severance of right petrosal sinus.
    d. Metal fragments in right temporal bone.
2. Cerebrum.
    a. Contusion-laceration and hemorrhage of right temporal lobe.
    b. Intraventricular hemorrhage due to above.
    c. Metal and bone fragments in right temporal lobe.
3. Cerebellum.
    a. Hemorrhagic tract and cavity in right cerebellar hemisphere.
    b. Metal and bone fragments in right cerebellar hemisphere.

B. Immediate Secondary Lesions.

1. Bone Lesion.
    a. Fracture of right supraorbital plate.

2. Meningeal Lesions.
    - a. Subdural hemorrhage.
    - b. Subarachnoid hemorrhage.
    - c. Laceration of right supraorbital dura.

3. Cerebral Lesions.
    - a. Contusion-laceration of right orbital gyri.
    - b. Contusion-laceration of right occipital lobe.
    - c. Contusion of contralateral (left) inferior temporal gyrus.

4. Cerebellum.
    - a. Hemorrhagic necrosis of cerebellar tonsils.

5. Brain Stem.
    - a. Hemorrhage in midbrain.
    - b. Hemorrhagic necrosis of left inferior olive of medulla.

6. Epidural hemorrhage of C1 and C2 vertebral level.

C. Later Secondary Lesions.

1. Edema of brain and herniations.
2. Subdural hemorrhage.
3. Subarachnoid hemorrhage.
4. Intracerebral and intraventricular hemorrhage.
5. Hemorrhagic infarction of right temporal cortex.
6. Intracerebellar and intraventricular hemorrhage.
7. Petechial hemorrhages of thalami.
8. Brain stem hemorrhage and early necrosis.
9. Herniation of cerebellum through craniotomy wound.
10. Early laminar necrosis of occipital lobe.

GUNSHOT WOUND NO. 2, THROUGH-AND-THROUGH.

ENTRY: Right axillary region.

COURSE: Soft tissue of right axilla and right infraclavicular region.

EXIT: ~~ENTRY:~~ Right infraclavicular region.

DIRECTION: Right to left, back to front, upward.

BULLET RECOVERY: None.

GUNSHOT WOUND NO. 3.

ENTRY:	Right axillary region (just below Gunshot Wound No. 2 entry).
COURSE:	Soft tissue of right axilla, soft tissue of right upper back to the level of the 6th cervical vertebra just beneath the skin.
EXIT:	None.
DIRECTION:	Right to left, back to front, upward.
BULLET RECOVERY:	.22 caliber bullet from the soft tissue of paracervical region at level of 6th cervical vertebra at 8:40 A.M., June 6, 1968.

EVIDENCE OF RECENT SURGICAL PROCEDURES.

1. Craniotomy, right temporal occipital.
2. Other, minor surgical procedures are described elsewhere.

PATHOLOGIC FINDINGS RELATED TO GUNSHOT WOUND NO. 1.

1. Hypostatic Pneumonia.

MISCELLANEOUS PATHOLOGIC FINDINGS NOT RELATED TO CAUSE OF DEATH.

1. Adenoma of left kidney (benign).
2. Retention cyst of left kidney.

DESCRIPTION OF GUNSHOT WOUNDS

GUNSHOT WOUND NO. 1:

The wound of entry, as designated by Maxwell M. Andler, Jr., M.D., Neurosurgeon attending the autopsy, and more or less evident by inspection of the apposed craniotomy incision, is centered 5 inches (12.7 cm) from the vertex, about 3/4 inch (1.9 cm) posterior to the center of the right external auditory meatus, about 3/4 inch (1.9 cm) superior to the Reid line, and 2-1/2 inches (6.4 cm) anterior to a coronal plane passing through the occipital protuberance at its scalp-covered aspect. The defect appears to have been about 3/16 inch (0.5 cm) in diameter at the skin surface. The surgical incision passing through the area of the wound of entry has been fashioned in a semilunar configuration with the concavity directed inferiorly and posteriorly. The incision has been intactly sutured by metallic and other material. The arc length is about 4 inches (10 cm).

Further detailed description of the area is given elsewhere in this report.

Varyingly moderate degrees of very recent hemorrhage are noted in the soft tissue inferior to the right mastoid region, extending medially as well. There is no hematoma in the soft tissue.

In conjunction with the wound of entry, the right external ear shows, on the posterior aspect of the helix, an irregularly fusiform zone of dark red and gray stippling about one inch (2.5 cm) in greatest dimension, along the posterior cartilaginous border and over a maximum width of about 1/4 inch (0.6 cm) at the midportion of the stippled zone. This widest zone of stippling is approximately along a radius originating from the wound of entry in the right mastoid region. Moderate edema and variable ecchymosis is present in the associated portions of right external ear as well.

No evidence of powder burn, tattoo, or stippling is found in the area surrounding the wound of entry of Gunshot Wound No.1, to include an arbitrary circular zone superimposed upon the above-described stippling on the right ear.

LESIONS IN DETAIL (NEUROPATHOLOGY)

A. Scalp and Cranium.

A U-shaped recent surgical wound is present over the right temporo-occipital region of the recently shaved scalp behind the right ear. Many wire sutures are in place. About 2 cm. above the tip of the mastoid process immediately behind the pinna at about the level of the external auditory meatus, the anterior portion of the skin of the incision shows a semi-circular defect said to be a portion of the original bullet entrance wound (according to the surgeons who were present at the examination). After removing the wire sutures, the scalp is incised by the usual mastoid-to-mastoid incision across the vertex. The incision on the right is extended into the surgical incision mentioned above. After reflecting the scalp, dark red subcutaneous and subgaleal hemorrhages are found in the right temporo-occipital region overlying and around the wound and the surgical craniotomy over an area measuring 9.5 x 10 cm. The hemorrhage ranges up to 3 mm in thickness. The right temporal muscle shows a small amount of hemorrhage along its posterior aspect.

The bony defect of the cranium included the superior portions of the right mastoid process and the adjacent temporo-occipital bones in an irregularly oval area measuring 6 x 5 cm. Gelfoam and hemorrhagic material is removed from the craniotomy site.

A circumferential cut with three notches is made in the calvarium with a vibratory saw. The calvarium is removed from the underlying dura. There is no lesion in this portion of the cranium.

The bone surrounding the craniotomy is removed in a single piece, including the posterior half of the right external auditory canal. The bullet wound in the skull appears to be located with its anterior margin 1 cm posterior to the right external auditory meatus, 2 cm superior to the tip of the mastoid process; but the original configuration is obscured by the surgical enlargement and by the adjacent craniotomy. The surgical opening of the right temporo-occipital bone measures 6 cm anteroposteriorly and 5 cm supero-inferiorly. Burr holes, saw cuts, and rongeur cuts can be seen along the margins of the bone.

The bullet wound of the mastoid extends medially to the base of the petrous portion where there is a triangular defect with the base of the triangle corresponding to the petrous ridge and measuring 8 mm in width.

A curved fracture about 1 cm long is found in the central thinnest portion of the right supra-orbital plate with intra-orbital hemorrhage beneath it surrounding the right eye. A laceration of the dura and contusion of the right orbital gyri are located above the fracture.

B. Meninges, blood vessels and cranial nerves.

In the dorsolateral aspect of the subdural space there is a